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DISCRETE APPLIED MATHEMATICS

Preface

We have collected in this volume ($2^{2^2}=$) 16 surveys presenting the state of the art in the rapidly growing area of discrete optimization. The surveys were presented by some of the most prominent researchers in this field at the Workshop on Discrete Optimization (DO'99), which was held at RUTCOR—Rutgers University Center for Operations Research, in the summer of 1999, and was attended by a large group of researchers representing the various facets of discrete optimization. We are extremely grateful to the authors of the expository lectures, which represent a comprehensive overview of the theoretical foundations, the methodology and the applications of discrete optimization.

DO'99 was held 22 years after DO'77, which had very similar goals, and whose collection of surveys gives even to this day a valuable image of the state of the art of our area a quarter of a century ago. It is interesting to compare the topics of the surveys presented in 1977 to those of 1999. Two striking characteristics emerge immediately, one being the continuity of topics, and the other being the maturing of new ideas which grow organically on the foundations present for more than 20 years. Among the noticeable research trends reflected in the collection we mention the evolution of large scale local search techniques, the substantial presence of applications geared to VLSI and telecommunications, and the impressive algebraization of the field.

We append to this preface, the table of contents of the two volumes of the state-of-the-art surveys of DO'77. We are happy to remark that those old surveys are still young, being used by many researchers, and still being quoted frequently in their papers. We do hope that the present collection of the state-of-the-art surveys in D.O., appearing here as a new volume of an ongoing series, will provide a similarly useful source of information and inspiration to the community as the first two volumes did for 25 years.

We are all looking forward to the next DO, and to many forthcoming volumes.

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DO'77 THE STATE of the ART 2^{-2} CENTURIES AGO
ANNALS of DISCRETE MATHEMATICS, VOLUMES 4 and 5, 1979

1. Combinatorial and polyhedral aspects of discrete optimization

Surveys

C. Berge, Packing problems and hypergraph theory: a survey
J. Edmonds, Matroid intersection
P.L. Hammer, Boolean elements in combinatorial optimization
A.J. Hoffman, The role of unimodularity in applying linear inequalities to combinatorial theorems
B. Korte, Approximative algorithms for discrete optimization problems
J.K. Lenstra and A.H.G. Rinnooy Kan, Computational complexity of discrete optimization problems
L. Lovász, Graph theory and integer programming
J. Tind, Blocking and antiblocking polyhedra

Reports

Complexity of combinatorial problems (R.L. Graham)
Structural aspects of discrete problems (P. Hansen)
Polyhedral aspects of discrete optimization (A.J. Hoffman)

2. Some fundamental classes of problems

Surveys

R.E. Burkard, Travelling salesman and assignment problems: a survey
P.C. Gilmore, Cutting stock, linear programming, knapsacking, dynamic programming and integer programming, some interconnections
V. Klee and D. Larman, Use of Floyd's algorithm to find shortest restricted paths
E.L. Lawler, Shortest path and network flow algorithms
M.W. Padberg, Covering, Packing and Knapsack problems

Reports

Network flow, assignment and travelling salesman problems (D. De Ghellinck)
Algorithms for special classes of combinatorial optimization problems (J.K. Lenstra)

3. Methodology

Surveys

E. Balas Disjunctive programming
P. Hansen, Methods of nonlinear 0–1 programming
R.G. Jeroslow, An introduction to the theory of cutting planes
E.L. Johnson, On the group problem and a subadditive approach to integer programming
J.F. Shapiro, A survey of lagrangian techniques for discrete optimization
K. Spielberg, Enumerative methods in integer programming

Reports

Branch and bound/implicit enumeration (E. Balas)
Cutting planes (M. Gondran)
Group theoretic and lagrangean methods (M.W. Padberg)

4. Computer codes

Surveys

E.M.L. Beale, Branch and bound methods for mathematical programming systems
A. Land and S. Powell, Computer codes for problems of integer programming

Reports

Current state of computer codes for discrete optimization (J.J.H. Forrest)
Codes for special problems (F. Giannessi)
Current computer codes (S. Powell)

5. Applications

Surveys

R.L. Graham, E.L. Lawler, J.K. Lenstra and A.H.G. Rinnooy Kan, Optimization and approximation in deterministic sequencing and scheduling: a survey
J. Krarup and P. Pruzan, Selected families of location problems
S. Zionts, A survey of multiple criteria integer programming methods

Reports

Industrial applications (E.M.L. Beale)

Modelling (D. Klingman)
Location and distribution problems (J. Krarup)
Communication and electrical networks (M. Segal)
Scheduling (A.H.G. Rinnooy Kan)
Conclusive remarks